



# ALACV PROGRAM



## ALACV Airburst Demonstration Full 40mm Cannon Caliber Ammunition

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# Presentation Outline



- Program objectives
- Program background
- 40mm projectile
- S&A
- Fuze Electronics
- Ballistic test data
- Test Video
- Fragmentation Data
- Summary



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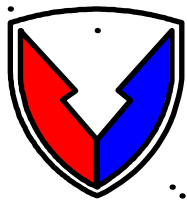
# Program Objective



- Develop and Demonstrate improved Air Bursting Munitions and Advanced KE capability in 40mm.
- Goal: Achieve a 400% increase in lethal area for Air Bursting Munitions, and a 30% increase in Behind Armor Effects for Advanced KE



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# Program Background



- Science and Technology Objective (STO) FY00-03
- Caliber: Super 40
- Utilized IPT to combine in-house, contract, and CRADA efforts
- Projectile Body
  - Designed by ARDEC Warheads Team
  - Produced by GD-OTS
- Partnering with Alliant Techsystems to provide Demo Fuze for Air Bursting Warhead demonstration & development for 40mm round



- S&A - ARDEC Fuze Division (in-house effort)



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- Electronics - ATK



# Demonstration Fuze Requirements



FY03 ballistic test with ARDEC projectile for warhead evaluation.

- Provide AB at 1500m from launch.
- Environments:
  - Setback: 80,000 Gs
  - Spin: 48,000 RPM
- Safety:
  - No Arm Distance: 60 meters
  - All Arm Distance: Dependent on command arm signal
- Base Fuze dimensions:
  - Height: 1.25"
  - Diameter: 1.22"



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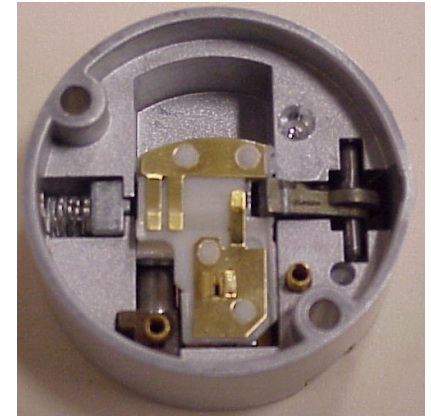
# ALACV S&A



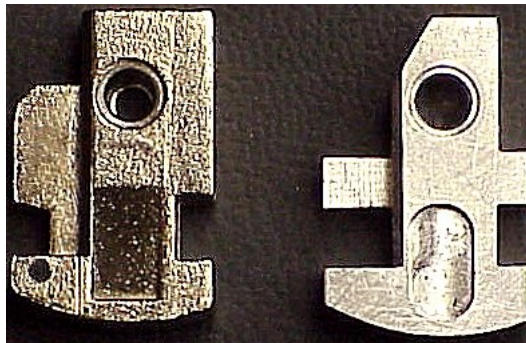
- Utilized M762 artillery S&A with the following modifications

- Reversed explosive train orientation
- Replaced spin lock with small cal spin lock
- Redesigned slider
  - Changed material from zinc die-cast to Al 7075-T6
  - Resulted in 40% weight reduction

ALACV S&A

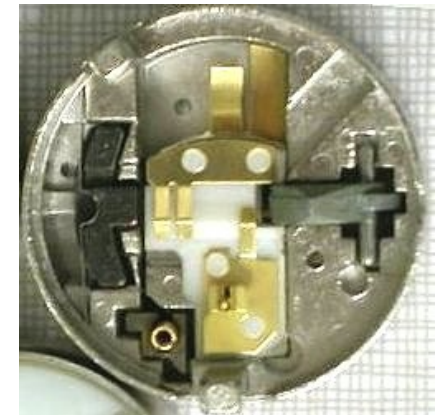


M762 Slider



ALACV Slider

M762 S&A



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# ALACV S&A Testing



- Explosive Train Test
  - Ensure PA537 detonator initiates PBXN-5 lead and PAX-2A main charge
  - Air gap spacing worst case
  - All 5 units functioned
  - Testing was conducted at the Explosive Development Facility bldg. 3024, Picatinny Arsenal, NJ
- Spin Test
  - 5 inert S&As subjected to 60,000 rpm spin environment
  - All units armed
- Out of Line Test
  - 8 S&As functioned out of line using PETN as acceptor
  - PETN did not function



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# ALACV Fuze Electronics



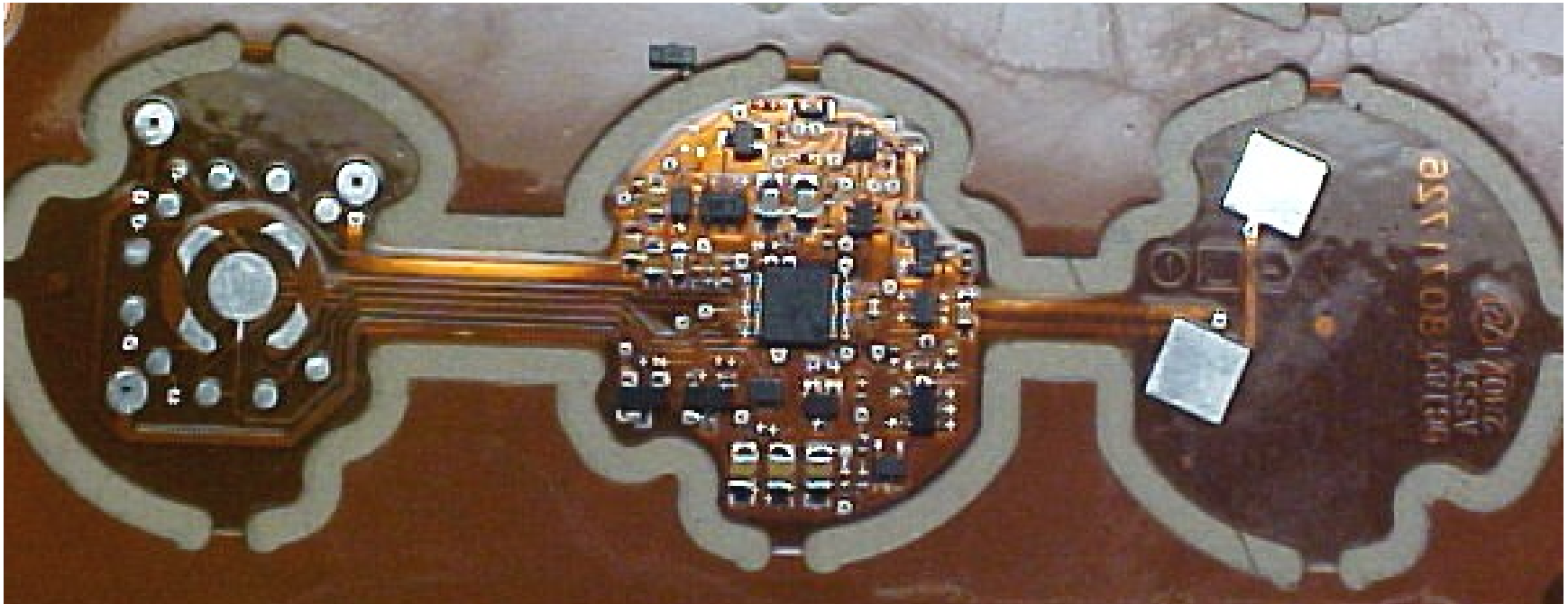
- Proven design repackaged for 40mm application
  - XM29 20mm, hundreds of successful tests
  - PAF 30mm, 36 successful air burst demonstration tests
  - XM29 20mm, MEMS S&A, initial testing very promising
- Turns Counting Circuitry
  - Reliable and accurate range estimation
- Fuze Modes
  - Only air burst mode implemented
  - Design compatible with additional modes such as PD and PDD
- Inductive set fuze
  - Reliable fuze setting



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# Fuze Circuit Panel



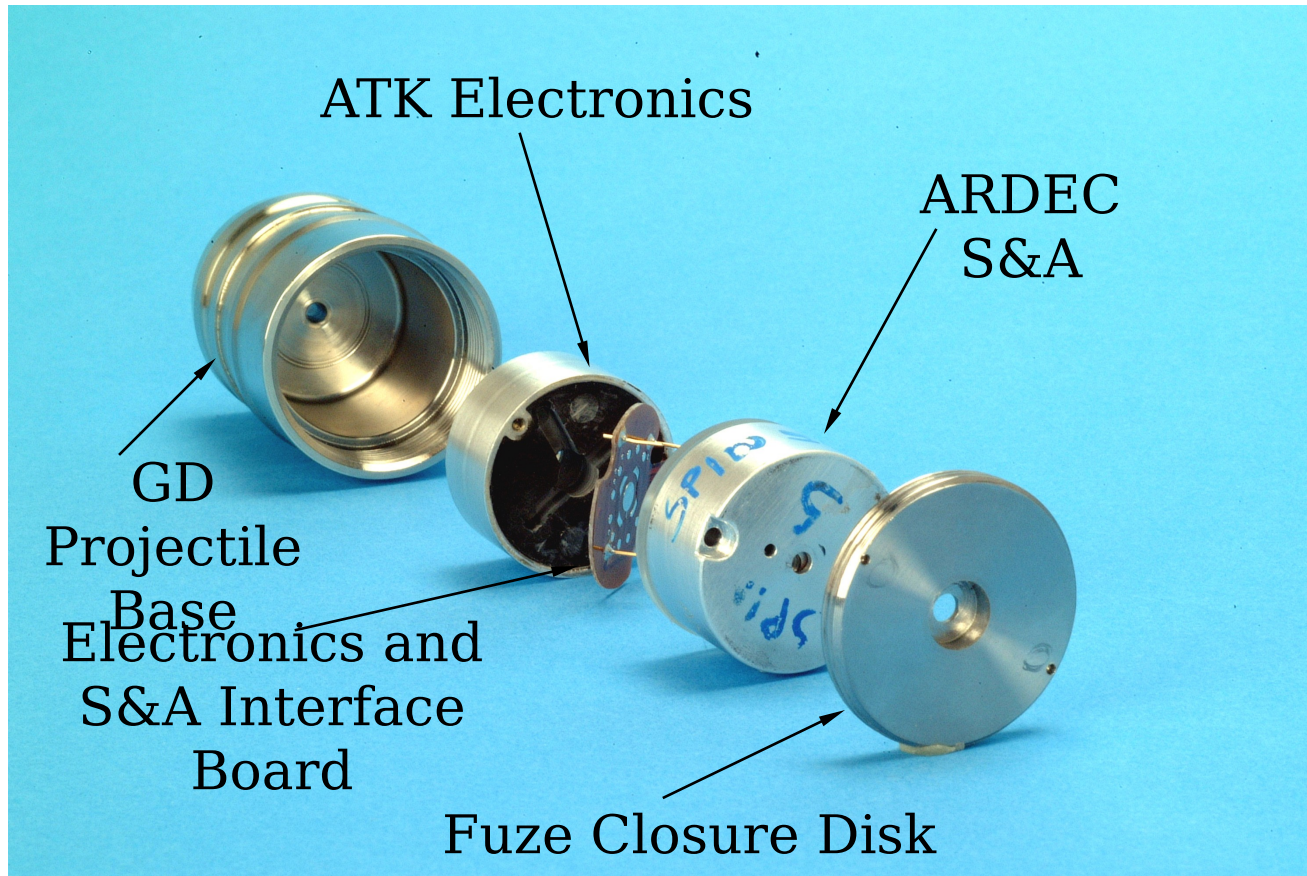
Designed To Meet Small Volume  
Requirements



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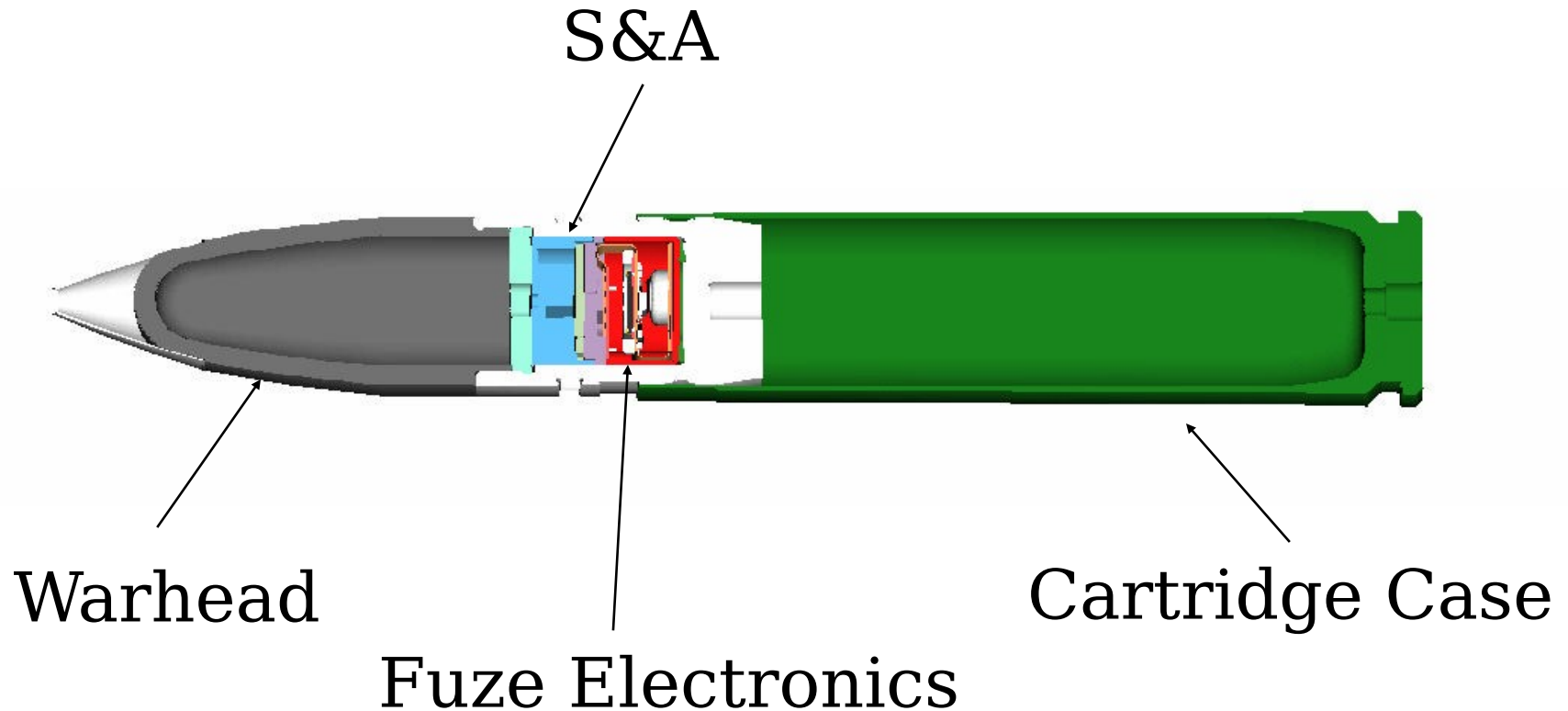
# ALACV Fuze Assembly



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# ALACV Cartridge Assembly



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# Tested ALACV Round Configuration



Rotating Band  
(Sintered Iron)

Windscreen  
(bonded w/  
3M  
adhesive)

Generation II  
Air Burst  
Warhead

Obturator Groove  
(Obturator is Nylon)



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# Fuze Development Tests



- Performed twelve 1500m soft-catch tests to assess fuze & projectile performance
  - Soft-catch series #1: S&A not arming, improved detonator and piston actuator contacts
  - Soft-catch series #2: Projectile compressing S&A on launch, turned down

rotating bands

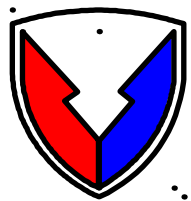
**Development Tests Paved The Path to**

- Soft-catch series #3: Good fuze function

**Air Burst Demonstration**



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# Successful Air Burst Demonstration



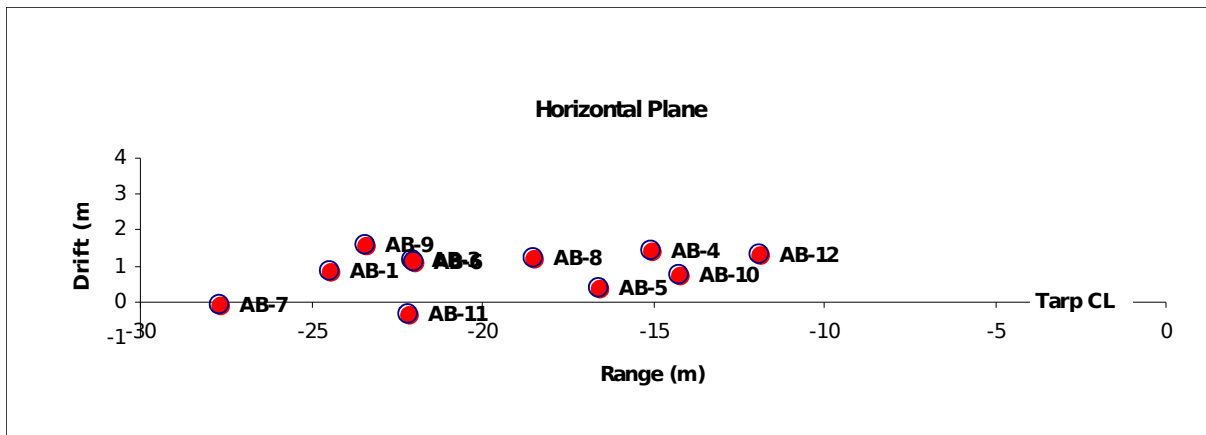
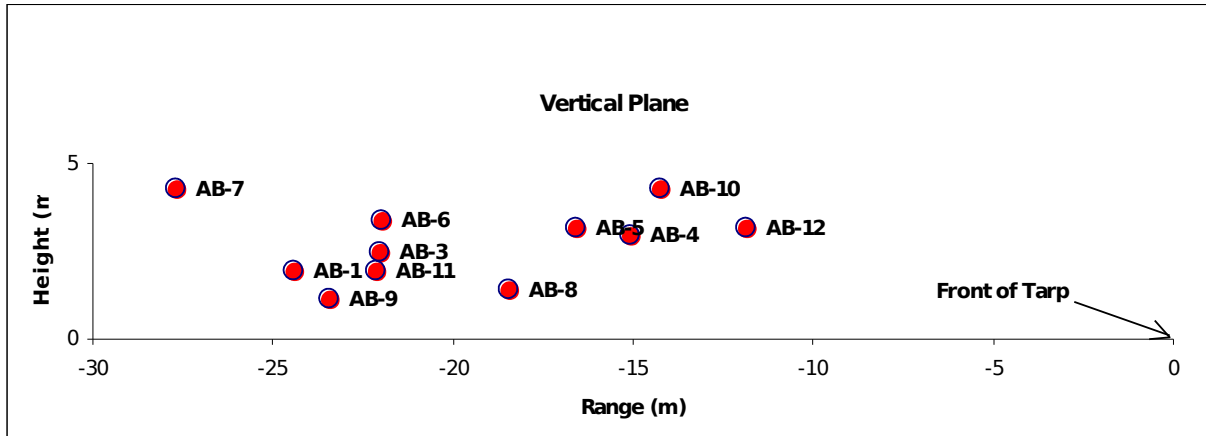
- December 2003, Alliant Techsystems Proving Ground in Elk River, Minnesota
  - 12 rounds fired
    - 6 rounds from Mann barrel
    - 6 rounds from MK44 auto gun including 3 round burst
  - Target
    - Dismounted infantry squad mannequins
    - ATGM site
    - All rounds functioned!



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# Air Burst Locations



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# ALACV Air Burst Data



1500 Meter 40mm ALACV Air Burst

| Date   | Air Press.<br>(mbars) | Air Temp<br>(°C) | Barrel   | Test ID      | Radar Data      |                  |            |
|--------|-----------------------|------------------|----------|--------------|-----------------|------------------|------------|
|        |                       |                  |          |              | Velocity<br>m/s | Burst Range<br>m | TOF<br>sec |
| 10-Dec | 976.6                 | -5               | Mann     | <b>AB-1</b>  | 935.7           | 1528.8           | 2.281      |
| 10-Dec | 976.9                 | -5               | Mann     | <b>AB-2</b>  | 941.2           | 1502.5           | 2.208      |
| 10-Dec | 977.2                 | -6               | Mann     | <b>AB-3</b>  | 940.2           | 1526.1           | 2.259      |
| 11-Dec | 982.3                 | -18.9            | Mann     | <b>AB-4</b>  | 940.8           | 1520.3           | 2.279      |
| 11-Dec | 982.3                 | -18.9            | Mann     | <b>AB-5</b>  | 943.2           | 1521.4           | 2.270      |
| 11-Dec | 982.3                 | -18.9            | Mann     | <b>AB-6</b>  | 943.7           | 1527.1           | 2.271      |
| 11-Dec | 983.1                 | -13.9            | Auto Gun | <b>AB-7</b>  | 945.3           | 1531.6           | 2.297      |
| 11-Dec | 983.1                 | -13.9            | Auto Gun | <b>AB-8</b>  | 949.1           | 1521.6           | 2.263      |
| 11-Dec | 983.1                 | -13.9            | Auto Gun | <b>AB-9</b>  | 942.9           | 1526.9           | 2.289      |
| 11-Dec | 983.7                 | -12.2            | Auto Gun | <b>AB-10</b> | 936.5           | 1518.1           | 2.286      |
| 11-Dec | 983.7                 | -12.2            | Auto Gun | <b>AB-11</b> | 947.5           | 1530.4           | 2.285      |
| 11-Dec | 983.7                 | -12.2            | Auto Gun | <b>AB-12</b> | 934.2           | 1515.4           | 2.295      |

|            |         |        |        |       |
|------------|---------|--------|--------|-------|
| All Rounds | Average | 941.69 | 1524.3 | 2.279 |
|            | Std Dev | 4.59   | 5.3    | 0.013 |

Range  
Error  $\sigma$

## Legend

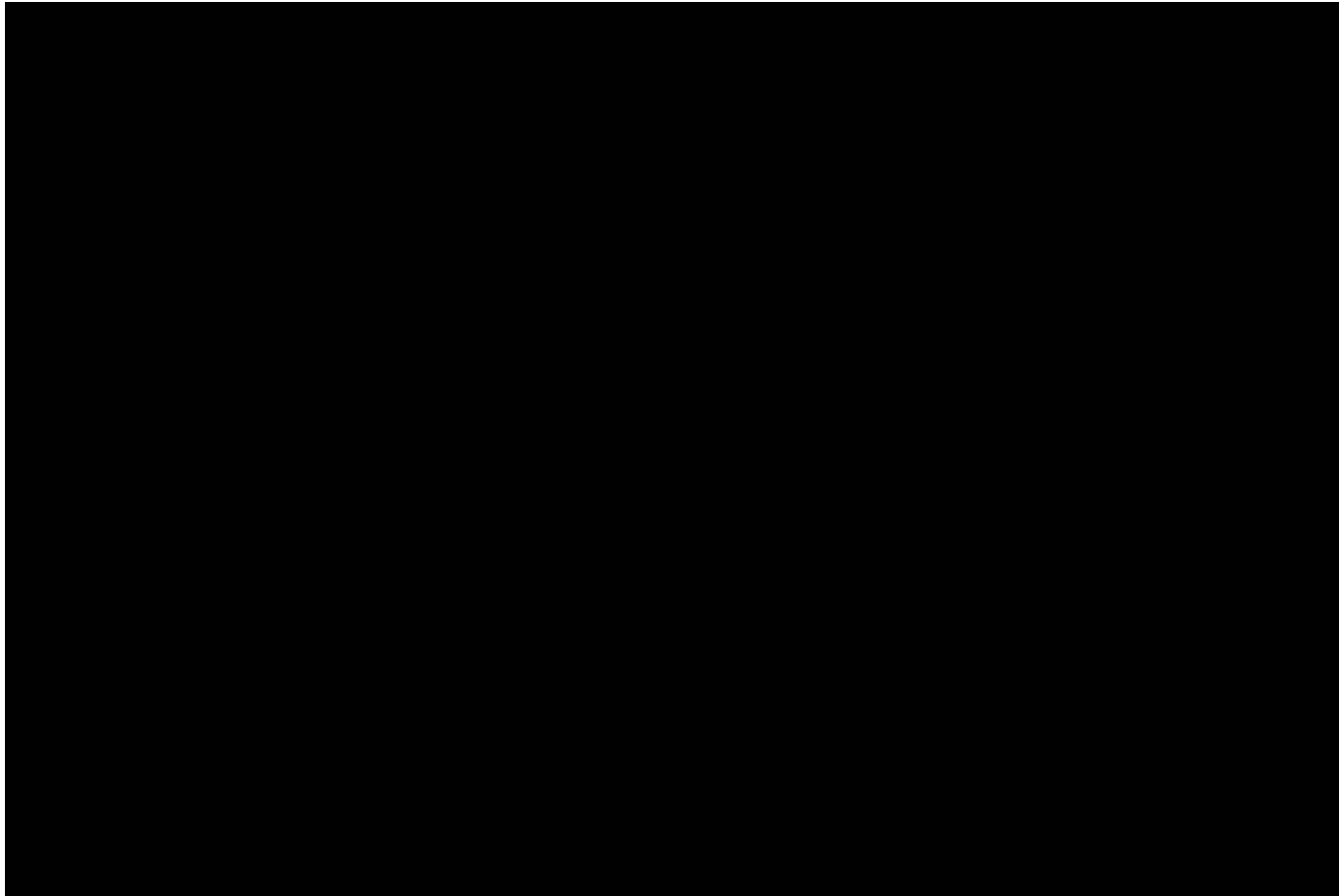
|  |                                                                 |
|--|-----------------------------------------------------------------|
|  | AB-2 Data excluded from statistics due to loss of rotating band |
|  | Auto Gun Three Round Burst                                      |



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# ALACV 40mm Demonstration Video



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# Summary



- Demonstrated airburst capability in a Super 40mm round
- Demonstrated increased lethality over current medium caliber ammunition
- Demonstrated accuracy of 5.3 meters at 1500 meter range



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